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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/837,007	04/18/2001	Mou-Shiung Lin	085027-0042	7677

89518 7590 01/31/2011  
McDermott Will & Emery LLP  
600 13th Street, NW  
Washington, DC 20005-3096

EXAMINER
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ZARNEKE, DAVID A

ART UNIT	PAPER NUMBER
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2891

NOTIFICATION DATE	DELIVERY MODE
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01/31/2011

ELECTRONIC

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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<b>Office Action Summary</b>	<b>Application No.</b> 09/837,007	<b>Applicant(s)</b> LIN ET AL.	
	<b>Examiner</b> David A. Zarneke	<b>Art Unit</b> 2891	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 8/27/09.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 55,57,58,60-62 and 66-80 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 55,57,58,60-62 and 66-80 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                     | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)          | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____  | 6) <input type="checkbox"/> Other: _____                          |

## **DETAILED ACTION**

### **Withdrawal of Non-Final Rejection**

The previous office action referred to incorrect claims in the non-final rejection and therefore is WITHDRAWN.

### ***Continued Examination Under 37 CFR 1.114***

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 8/27/09 has been entered.

### ***Response to Arguments***

Applicant's arguments filed 8/27/09 have been fully considered but they are not persuasive. Two arguments were presented with respect to the rejection of the claims. First, it is argued that it isn't obvious to use Ti or Ni containing layers in the invention of Nozawa because Farnworth doesn't teach the use of a cylinder and therefore isn't readily applied to the bump of Nozawa because the mechanical considerations and circumstances of each reference are different.

Please note that the references don't have to be exactly the same in order to be combinable. Regardless of the particulars of each reference, the Ti and Ni layers of Farnworth are combinable because they both teach the use of bumps in the making of a semiconductor package. In response to applicant's argument that the bumps of Farnworth are nonanalogous art, it has been held that a prior art reference must either be in the field of applicant's endeavor or, if not, then be reasonably pertinent to the particular problem with which the applicant was concerned, in order to be relied upon as a basis for rejection of the claimed invention. See *In re Oetiker*, 977 F.2d 1443, 24 USPQ2d 1443 (Fed. Cir. 1992). In this case, prior art reference must either be in the field of applicant's endeavor. The application of Ni and Ti containing layers of Farnworth readily apply to most any bump regardless of the particulars surrounding that bump, for example whether there is a cylinder underneath or not, because the benefits of these layers aren't dependent upon those particulars, in this case the cylinder.

The second argument is that it isn't obvious to use an underfill in the invention of Nozawa because (1) the polymer layer surrounding the cylinders provide the necessary support, therefore making an underfill unnecessary; and (2) the connecting structure of Nozawa is significantly different than conventional flip-chip bonding.

Please note that while the polymer layer may provide the necessary support, it doesn't provide any other benefit associated with the use of underfills, such as the protection of the bumps from environmental considerations. Further, as noted above, the fact that the structure is different doesn't preclude the benefits of using an underfill.

Art Unit: 2891

Stated another way, the benefits of using an underfill are not generally dependent upon the surrounding structure, in this case the use of a cylinder.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

Claims 55, 57, 58, 60-62, and 66-80 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nozawa, US Patent 6,181,010.

Nozawa (figures 2 & 9) teaches a chip package; comprising:

a substrate [1000] having a first side and a second side opposite to said first side, wherein said substrate comprises multiple contact points at said second side (while not specifically teaching this, this is inherent to a circuit board, a circuit board is useless unless it can be interconnected to another substrate to form a device.

Art Unit: 2891

Therefore, the circuit board [1000] must have multiple contact points on the second side);

a chip [100] over said first side of said substrate, wherein said chip comprises a silicon substrate;

a copper (4, 48+) pillar [22] between said first pad and a second metal pad of said multiple layers of interconnecting lines, wherein said metal pillar is connected to said second metal pad through an opening in said polymer layer, and wherein said copper pillar has a thickness between 10 and 100 micrometers (4, 50-57);

a solder metal [200] between said copper pillar and said first pad, wherein said solder metal is connected to said first pad; and

a layer [124] between said copper pillar and said solder metal.

Nozawa teaches the chip as having the a solder mask [106] at said first side, an interconnect covered by said solder mask and a first metal pad [104] comprising a region uncovered by said solder mask, wherein said first metal pad is connected to said interconnect; but fails to teach the substrate has these limitations.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use these limitations on the circuit board [1000] instead of on or in addition to the chip in the invention of Nozawa because it is conventionally known and used in the art to form these layers on the substrate as opposed to the chip. A skilled artisan would know that these limitations could be used on the substrate instead of on the chip. The substitution of one known equivalent technique for another may be obvious even if the prior art does not expressly suggest the substitution (Ex parte Novak 16 USPQ 2d

Art Unit: 2891

2041 (BPAI 1989); In re Mostovych 144 USPQ 38 (CCPA 1964); In re Leshin 125 USPQ 416 (CCPA 1960); Graver Tank & Manufacturing Co. V. Linde Air Products Co. 85 USPQ 328 (USSC 1950).

Nozawa fails to teach the chip comprises multiple layers of interconnecting lines comprising copper, multiple insulating layers comprising an oxide material, multiple metal vias in said multiple insulating layers and between said multiple layers of interconnecting lines, wherein said multiple metal vias are connected to said multiple layers of interconnecting lines, and a polymer layer.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use the multiple layers in the invention of Nozawa because these are conventionally known in the art layers used to redistribute the pads on the chip. The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

Nozawa fails to teach a titanium-containing layer between said second pad and said metal pillar, wherein said under bump metal layer is on said second metal pad, on said polymer layer and in said opening in said polymer layer.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a titanium containing layer in the invention of Nozawa because a titanium containing layer is conventionally known in the art layer used as barrier layer or a wetting/adhesion layer on a pad, as evinced by Farnworth, US Patent 5,851,911 (2, 28-44). The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

Art Unit: 2891

Nozawa fails to teach the layer [124] is a nickel-containing layer.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a nickel-containing layer in the invention of Nozawa because a nickel-containing layer is conventionally known in the art layer used as barrier layer or a wetting/adhesion layer, as evinced by Farnworth, US Patent 5,851,911 (2, 28-44). The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

Nozawa further fails to teach an underfill between said semiconductor device and said substrate, wherein said underfill contacts with said semiconductor device and said substrate and encloses said metal pillar and said solder metal.

It would have been obvious to one ordinary skill in the art at the time of the invention to use an underfill between said semiconductor device and said substrate because underfills are commonly known used by skilled artisans to protect and strengthen the package, as evinced by Farnworth, US Patent 5,851,911 (2, 1-5). The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

Regarding claim 70, Nozawa (figures 2 & 9) teaches a chip package; comprising:  
a substrate [1000] having a first side and a second side opposite to said first side, wherein said substrate comprises multiple contact points at said second side, a solder mask [106] at said first side, an interconnect covered by said solder mask and a first metal pad [104] comprising a region uncovered by said solder mask, wherein said first metal pad is connected to said interconnect;



Art Unit: 2891

a chip [100] over said first side of said substrate, wherein said chip comprises a silicon substrate,

a copper (4, 48+) pillar [22] between said first pad and a second metal pad of said multiple layers of interconnecting lines, wherein said metal pillar is connected to said second metal pad through an opening in said polymer layer, and wherein said copper pillar has a thickness between 10 and 100 micrometers (4, 50-57);

a solder metal [200] between said copper pillar and said first pad, wherein said solder metal is connected to said first pad; and

a layer [124] between said copper pillar and said solder metal.

Nozawa fails to teach the chip comprises multiple layers of interconnecting lines comprising copper, multiple insulating layers comprising an oxide material, multiple metal vias in said multiple insulating layers and between said multiple layers of interconnecting lines, wherein said multiple metal vias are connected to said multiple layers of interconnecting lines, and a polymer layer.

It would have been obvious to one of ordinary skill in the art at the time of the invention to use the multiple layers in the invention of Nozawa because these are conventionally known in the art layers used to redistribute the pads on the chip. The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

Nozawa fails to teach an metal layer between said second pad and said metal pillar, wherein said metal layer is on said second metal pad, on said polymer layer and in said opening in said polymer layer.

Art Unit: 2891

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a metal layer in the invention of Nozawa because a metal layer is conventionally known in the art layer used as barrier layer or a wetting/adhesion layer on a pad. The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

Nozawa further fails to teach an underfill between said semiconductor device and said substrate, wherein said underfill contacts with said semiconductor device and said substrate and encloses said metal pillar and said solder metal.

It would have been obvious to one ordinary skill in the art at the time of the invention to use an underfill between said semiconductor device and said substrate because underfills are commonly known used by skilled artisans to protect and strengthen the package. The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

Regarding claim 57, Nozawa teaches said substrate further comprises multiple third pads (figure 9 shows multiple pads) uncovered by said solder mask, wherein said solder mask is separate from said first metal pad and from said multiple third metal pads, and wherein said first pad and said multiple third metal pads are aligned in a direction parallel with a sidewall of said solder mask, wherein said first metal pad is connected to said interconnect through said sidewall.

With respect to claim 58, Nozawa teaches said copper pillar has a first sidewall recessed from a second sidewall of said nickel-containing layer (figure 2), but fails to

Art Unit: 2891

teach a distance between said first sidewall and said second sidewall is greater than 0.2 micrometers.

It would have been obvious to one ordinary skill in the art at the time of the invention to optimize the distance to be greater than 0.2 micrometers through routine experimentation (MPEP 2144.05).

In re claims 60 and 72, while Nozawa, which teaches a circuit board (PCB) (8, 30+), fails to teach said substrate comprises a ball grid array substrate, it would have been obvious to one of ordinary skill in the art at the time of the invention to substitute a BGA for a PCB in the invention of Nozawa because BGAs and PCBs are known equivalent substrates to which semiconductor devices are attached. The substitution of one known equivalent technique for another may be obvious even if the prior art does not expressly suggest the substitution (Ex parte Novak 16 USPQ 2d 2041 (BPAI 1989); In re Mostovych 144 USPQ 38 (CCPA 1964); In re Leshin 125 USPQ 416 (CCPA 1960); Graver Tank & Manufacturing Co. V. Linde Air Products Co. 85 USPQ 328 (USSC 1950).

Regarding claims 61 and 73, while Nozawa fails to teach said multiple contact points comprise multiple contact balls at said second side, it would have been obvious to one of ordinary skill in the art at the time of the invention to use contact balls at said second side in the invention of Nozawa because contact balls are conventionally used in order to attach the package to the next level of integration. The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

Art Unit: 2891

As to claims 62 and 74, though Nozawa fails to teach the first metal pad has a circular shape, the shape of the pad is an obvious matter of design choice. Design choices and changes of size are generally recognized as being within the level of ordinary skill in the art (MPEP 2144.04(I), (IVA) & (IVB)).

In re claims 66 and 75 , though Nozawa fails to teach said nickel-containing layer has a thickness between 1 and 10 micrometers, it would have been obvious to one of ordinary skill in the art at the time of the invention to optimize the nickel-containing layer thickness through routine experimentation (MPEP 2144.05).

Regarding claim 67, though Nozawa fails to teach said titanium-containing layer comprises titanium nitride, it would have been obvious to one of ordinary skill in the art at the time of the invention to use titanium nitride in the invention of Nozawa because titanium nitride is a conventionally known in the art material used as a barrier layer. The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

As to claims 68 and 76, though Nozawa fails to teach said copper pillar is electroplated, it would have been obvious to one of ordinary skill in the art at the time of the invention to electroplate the copper pillar in the invention of Nozawa because electroplating is a conventionally known in the art method used to deposit copper. The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

In re claim 71, Nozawa teaches metal layer [124] between said copper pillar and said solder metal, but fails to teach the layer is a nickel-containing layer.

Art Unit: 2891

It would have been obvious to one of ordinary skill in the art at the time of the invention to use a nickel-containing layer in the invention of Nozawa because a nickel-containing layer is conventionally known in the art layer used as barrier layer or a wetting/adhesion layer. The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

Regarding claims 77-80, though Nozawa fails to teach said metal layer comprises titanium (claim 77), specifically titanium nitride (claim 78), or tungsten (claim 79) or tantalum (claim 80), it would have been obvious to one of ordinary skill in the art at the time of the invention to use a titanium nitride or tungsten or tantalum layer in the invention of Nozawa because a titanium nitride or tungsten or tantalum layer are conventionally known in the art layers used as barrier layer or a wetting/adhesion layer. The use of conventional materials to perform their known functions is obvious (MPEP 2144.07).

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to David A. Zarneke whose telephone number is (571)-272-1937. The examiner can normally be reached on M-Th 7:30 AM-6 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Sue Purvis can be reached on (571)-272-1236. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Art Unit: 2891

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/David A. Zarneke/  
Primary Examiner, Art Unit 2891  
1/22/11